from *C. britannicus*, Verhoeff, and *C. frisius*, Verhoeff, both of which are not uncommon English species. However, the gonopods, which are figured by Brölemann and Verhoeff (*loc. cit.*), are quite definite diagnostic characters, and so there is no doubt about the record. Our material bears these numbers :—1379, 1380, 1381, 1382, Brade-Birks collection.

Reference.

(1) Brölemann, H. W., and C. W. Verhoeff. "Matériaux pour servir à une faune des Myriapodes de France." Feuille des Jeunes Naturalistes, Sept. 1896, no. 311, pp. 214 *et seq.*, with 10 text-figs.

XLVIII.—*Note on the Pectoral Fin of* Eusthenopteron.

By Dr. Branislav Petronievics.

The pectoral fin of *Eusthenopteron* was figured and described for the first time by Whiteaves (comp. J. F. Whiteaves, 1889, p. 87, & pl. v. fig. 5), whose description was improved by Traquair (comp. R. H. Traquair, 1890, p. 19). Two other specimens of the same fin were figured by A. S. Woodward (1898, p. 25) and W. Patten (1912, p. 391).

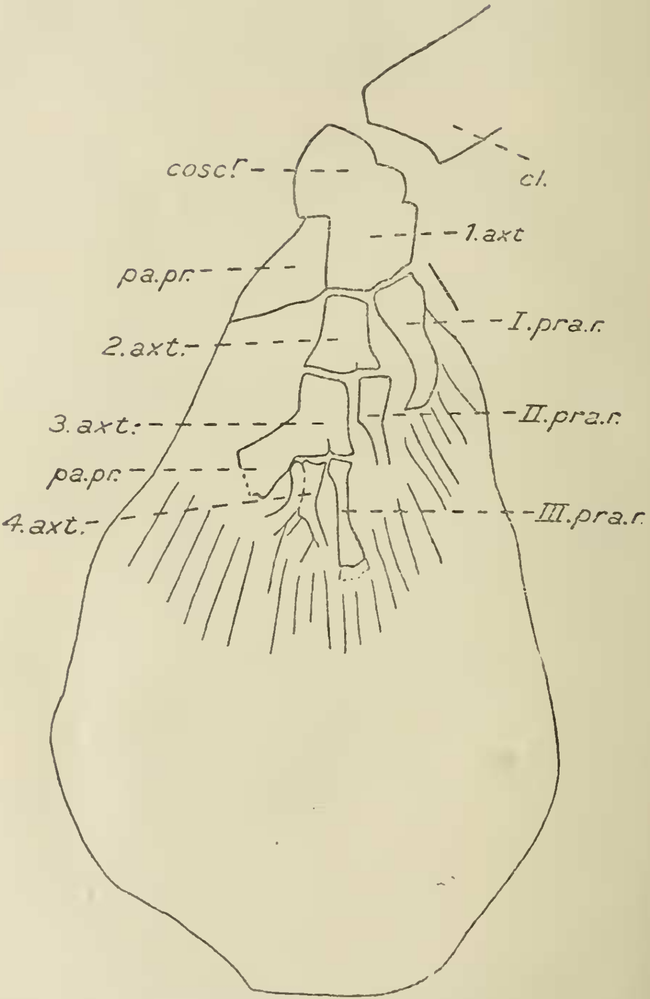
During my stay in London this year the pectoral fin in the British Museum specimen P. 6796 of *Eusthenopteron*, figured by A. S. Woodward (whose figure was republished by E. S. Goodrich in 1902, pl. xvi. fig. 1), was somewhat newly prepared by Mr. F. O. Barlow. I give here a new figure of it (comp. text-fig. 1) and a brief description.

The pectoral fin in our specimen is composed (1) of an axis, (2) of preaxial radials, and (3) of postaxial processes.

The axis consists of four pieces. The first or basal piece is situated behind the displaced cleithrum, of which the inferior edge lies near to its superior edge in the specimen. It is not possible to decide whether this elongated and somewhat obscure bony matter is to be identified wholly with the basal piece of the fin, or whether it does not comprise also the coraco-scapular ossification. Should this latter be the case, then the front edge of the postradial process of the basal would mark the limit between the basal and coraco-scapula.

The second piece of the axis is expanded and slightly bifurcated posteriorly. The third piece is somewhat longer than the second and expanded still more posteriorly, where it has not only a large postaxial process, but is also more distinctly bifurcated.

Fig. 1.



Pectoral Fin of *Eusthenopteron*, British Museum specimen P. 6796. Nat. size.

cl., cleithrum; *cosc.*, the possible coraco-scapula; *1.axt.*, the first axonost or the basal; *2.axt.*, second axonost; *3.axt.*, third axonost; *4.axt.*, fourth axonost; *I.pra.r.*, first preaxial radial; *II.pra.r.*, second preaxial radial; *III.pra.r.*, third preaxial radial; *pa.pr.*, postaxial process; dermal rays are represented by lines.

Finally, the fourth piece of the axis is somewhat constricted in the middle, and quite distinctly bifurcated posteriorly (a feature not marked in the figure of A. S. Woodward, 1898). When looked at with a magnifying-glass, these two posterior branches seem to continue in two separate ossifications, so that the composition of this fourth axonost of two separate parts is not improbable, although not to be affirmed with certainty, the separating line between the two being perhaps due to a crack. One sees also with the magnifying-glass the clear attachment of a dermal ray to the left of these two bifurcations, while a fragment of somewhat crushed bony matter attached to the right bifurcation also probably represents dermal rays.

There are three preaxial radials in our specimen. The uppermost radial is attached to one of the two articulating surfaces of the basal axonost ; it is bent inwards in the middle and constricted posteriorly. The new preparation shows the attachment of the dermal rays to this radial very clearly. The second radial, attached to the smaller of the two articulating surfaces of the second axonost, is also constricted posteriorly, but not sufficiently preserved in its posterior part. The third radial, better preserved than the second, is constricted in the middle, but the limit of its posterior part is indeterminable. It is attached to the smaller of the two articulating bifurcations of the third axonost.

There are only two postaxial processes in our specimen, and no postaxial radials at all. The first process is a large prolongation of the basal axonost (this prolongation is not well visible in the figure of A. S. Woodward, 1898), and the second a prolongation of the third axonost, while the second and the fourth axonosts are devoid of similar processes (on the left side of the second axonost some bony matter is visible in our specimen, but it is evidently a crushed scale).

Having finished the description of the fin in question, I will add some remarks concerning the problem of the origin of the tetrapod limb. The resemblance of the internal skeleton of the pectoral (and also of the pelvic) fin in *Eusthenopteron* to the internal skeleton in the tetrapod limb has been emphasized by several authors (by Patten, Watson, Broom, Gregory), and Watson especially has tried to point out in detail the homologies of both (comp. Watson, 1913, p. 25 *seq.* and figs. 1 & 2). But his restoration of the pectoral fin of *Eusthenopteron* (*l. c.* fig. 2) is wrong, inasmuch as he takes no account of the posterior bifurcation of the fourth axonost (in this respect the restoration of Broom, 1913, p. 460, fig. 1, is more accurate) and represents the postaxial process of the basal axonost as a separate postaxial radial (in this respect the restoration of Broom is exact).

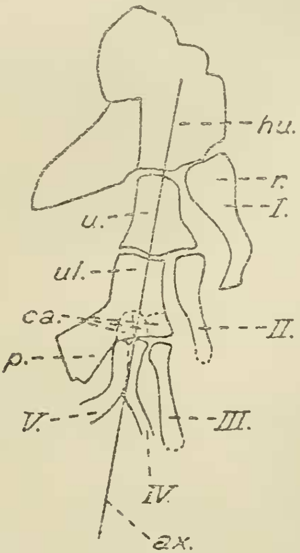
Now I consider the posterior bifurcation of the fourth axonost in our specimen as of exceptional importance for the question of homologies. As the pelvic fin of *Eusthenopteron* is far more reduced than its pectoral fin (comp. fig. 1 of pl. xvi. in Goodrich, 1902, which shows that there is no fourth axonost in the pelvic fin—British Museum specimen P. 6794—and no postaxial processes), we must infer that the paired fins of *Eusthenopteron* represent a stage far in advance of that stage of the paired fins in its ancestors, which was the starting-point for the evolution of the paired limbs in the primitive ancestors of the Tetrapoda *. If this inference is a right one, then it is not improbable that the posterior bifurcation of the fourth axonost in our specimen is a remnant of a more primitive stage when the fourth axonost was composed of two separate ossifications, the paired fins of *Eusthenopteron* being evidently the reduced archipterygium-type of Gegenbaur (a resemblance recognized by Woodward, Traquair, and others). So that we have to conclude from this evolution that the axis of the tetrapod limb runs along the humerus, ulna, ulnare, and between the fourth and fifth finger † (comp. text-fig. 2, in which some further hypothetical homologies have been indicated). This conclusion, as one sees,

* This conclusion is confirmed also by the skull, which in *Eusthenopteron* is simpler than in the more primitive Osteolepidæ, whose paired fins are also less reduced (comp. the fins of *Megalichthys* figured by Ed. D. Wellburn in his paper "On the Genus *Megalichthys*," in Proc. Yorkshire Geol. & Polytechnic Soc. vol. xiv., 1900). I may add in this connexion that the skull of *Osteolepis* may be considered to approach nearer to the Stegocephalian skull than is shown by the restoration of Pander (comp. Chr. H. Pander, 'Ueber die Saurodipterinen, &c.,' 1860, pl. i. figs. 8 & 9), lately reproduced by Gregory (comp. Gregory, 1915, fig. 2, A, B). Pander's restoration was founded on the specimen of *Osteolepis microlepidotus* figured by him in pl. i. fig. 1; but fig. 4 on the same plate represents a specimen in which all the three characteristic bones of the Stegocephalian skull (supratemporal, intertemporal, postorbital) are present.

† The pectoral fin of *Sauripterus taylori* (figured and restored by Gregory, 1915, plate iv. and fig. 9) does not militate against this supposition. This fin, less reduced than that of *Eusthenopteron*, has three elements attached to the third axonost, so that these three elements may correspond with the three digits on the ulnar side of the tetrapod limb. As the two outer of these three elements have almost the same length, it may well be supposed that the axis runs between the two (and not along the outer one alone, as Gregory hypothetically supposes—comp. Gregory, 1915, p. 360). I should mention that the first to emphasize the resemblance of the *Sauripterus*-fin with the tetrapod limb was its discoverer, James Hall himself (comp. J. Hall, 'Geology of New York,' part iv. 1843, p. 282).

does not entirely confirm the theory of Gegenbaur, according to which the tetrapod limb is derived from a reduced uniserial archipterygium (comp. Gegenbaur, 1898, p. 520), but nevertheless it is more in conformity with this theory than with the other (also advocated by Watson), which takes a reduced biserial archipterygium for the base of the tetrapod limb.

Fig. 2.



The internal skeleton of the Pectoral Fin of *Eusthenopteron*, showing homologies with the tetrapod limb. Nat. size.

hu., humerus; *u.*, ulna; *r.*, radius; *ul.*, ulnare; *p.*, pisiform; *ca.*, three distal carpalia; *I.–V.*, digits; *ax.*, axis of the tetrapod limb.

In conclusion, I desire to express my thanks to Dr. Smith Woodward for the loan of the new preparation and for valuable help.

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XLIX.—*Descriptions and Records of Bees.*—LXXXII. By T. D. A. Cockerell, University of Colorado.

Exomalopsis mellipes, Cresson.

The male, not before known, has been collected by H. H. Hyde at Medellin, Vera Cruz, Mexico (Baker coll., 1785). It runs in Friese's table of males to *E. planiceps*, Sm., but is larger, with red legs.

Exomalopsis vincentana, Cockerell.

The male, previously unknown, was collected by H. H. Smith on the windward side of St. Vincent. It is hardly 5 mm. long, and there is much black hair on mesothorax, scutellum, and legs. It is nearest to *E. globosa*, but distinguished at once by the ochreous-yellow tarsi.

There is a series of small *Exomalopsis* (including *Anthophorula*), which are superficially similar and easily confused. They may be separated by the following table, based on females :—

Second abdominal segment with oblique stripes of light hair at sides, but no apical band .... 1.